TWO MODELS FOR TWO-HOP RELAY ROUTING WITH LIMITED PACKET LIFETIME

Namicheishvili Oleg[1], Meladze Hamlet [2], Aslanishvili Irma[2]
1-Georgian Technical University,
2-St.Andrew the First-Called Georgian University
of the Patriarchy of Georgia

Summary

We study mobile communication of networks, the ad hoc networks, has attracted Signing cant attention due to its challenging research problems. Ad hoc networks are complex distributed systems that consist of wireless mobile or static nodes that can freely and dynamically self-organize. We will use of the finite-state continuous- time absorbing Markov Chain to computer the above performance metrics. The first model is introduce the two-hop relay mechanism, that works as follow: when there is no rote between the source node and the destination node, the source node transmits copies of packets to all neighboring nodes. That it meets for delivery to the destination. The objective of this paper is to study the packet delivery limited lifetime. The second model is for two-hop relay Routing with limited Packet Lifetime with a single parameter in a random medium. where the source node wants to send a single packet to the destination node. mentioned statement of the problem can be done in the following way: any complex behavior based on a finite storage space can be represented as being generated by a realization algorithm for two-hop relay Routing with limited Packet Lifetime and with a finite memory.

Keywords: Hoc networks. MANETs protocols. Routing protocols. Packet. Source node. Markov chain. Absorbing state. Relay routing. Finite memory.

1. Introduction

For the last twenty years, mobile communications have experienced an explosive growth. In particular, one area of mobile communication networks, the ad hoc networks, has attracted Signing cant attention due to its challenging research problems. Ad hoc networks are complex distributed systems that consist of wireless mobile or static nodes that can freely and dynamically self-organize. In this way they form arbitrary and temporary ad hoc network topologies, allowing devices to seamlessly interconnect in areas with no pre-existing infrastructure.

We are captured through a single parameter, representing the expected inter-meeting time consider the model introduced. In this model the characteristics of MANETs between any pair of nodes. More precisely, there are N + 1 nodes consisting of: one source node, one destination node, and N -1 relay nodes. Two nodes may only communicate at certain points in time, called meeting times. The time that elapses between two consecutive meeting times of a given pair of nodes is called the inter-meeting time. In it is assumed that inter-meeting times are mutually independent and identically distributed random variables. Throughout we address the scenario where the source node wants to send a single packet to the destination node. To this end the source may use the relay nodes according to the MTR protocol, as explained below the source is always able to send a copy to another node.

We assume that the source is ready to transmit the packet to the destination at time t = 0. The delivery time T_∞, is the time after t = 0 when the destination node receives the packet. The latter is related to the overhead induced by the MTR protocol in particular, to the total energy needed to deliver the packet to the destination. We will use of the finite-state continuous- time absorbing Markov Chain to computer the above performance metrics.

2. Two-hop relay Routing with limited Packet Lifetime with Mobile Ad Hoc Networks (MANETs)

Ad hoc networks are complex distributed systems that consist of wireless mobile or static nodes that can freely and dynamically self-organize. In this way they form arbitrary and temporary ad hoc network topologies, allowing devices to seamlessly interconnect in areas with no pre-existing infrastructure.

We are captured through a single parameter, representing the expected inter-meeting time consider the model introduced. In this model the characteristics of MANETs between any pair of nodes. More precisely, there are N + 1 nodes consisting of: one source node, one destination node, and N -1 relay nodes. Two nodes may only communicate at certain points in time, called meeting times. The time that elapses between two consecutive meeting times of a given pair of nodes is called the inter-meeting time. In it is assumed that inter-meeting times are mutually independent and identically distributed random variables.

Throughout we address the scenario where the source node wants to send a single packet to the destination node. To this end the source may use the relay nodes according to the MTR protocol, as explained below the source is always able to send a copy to another node.

We assume that the source is ready to transmit the packet to the destination at time t = 0. The delivery time T_∞ is the time after t = 0 when the destination node receives the packet. The latter is related to the over head induced by the MTR protocol in particular, to the total energy needed to deliver the packet to the destination. introduce the two-hop relay mechanism, that works as follow: when there is no rote between the source node and the destination node, the source node transmits copies of packets to all neighboring nodes. That it meets for delivery to the destination. The objective of this paper is to study the packet delivery limited lifetime.

At time $t = 0$, the source is ready to transmit the packet the destination. Let denotes the packet delivery time (or delivery delay), defined to as the first time T_d after $t = 0$ when the destination node receives the packet (or a copy of the packet). Let G_d denotes the number of copies generated by the source before the delivery time. The state of the system for $t < Td$ is represented by the random variable $I(t) \in \{1, 2, \ldots, N\}$, where $I(t)$ gives the number of copies. For $t \geq Td$, it is assumed that the state of the system, $I(t)$, is a. Under the assumptions made, $\{I(t), t \geq 0\}$ is an absorbing, finite state continuous-time Markov chain, with transient states $\{1, 2, \ldots, N\}$ and absorbing state a. Let **MC** denotes the absorbing, finite-state, discrete-time Markov chain *embedded* just before the jump times of the Markov chain $\{I(t), t \geq 0\}$. Let $m(i, j)$ be the (i, j)-entry of the fundamental matrix of **MC**. Recall that $m(i, j)$ gives the expected number of visits to transient state j before absorption (or delivery time) given that $I(0) = i$. The following propositions hold.

Lemma: Consider a finite –state continuous-time, Markov Chain $\{M(t), t \geq 0\}$, of states space ξ={1,…,n, n+1,…n +s}and infinitesimal generator matrix, G, of from

$$G\begin{pmatrix} U & V \\ O_n & O_s \end{pmatrix}$$

where U is a n-by n matrix, V is a n by n-matrix, $O_n$is a s-by n matrix of all entries equal to 0, $O_s$is a sby s matrix of all entries equal to 0. The states { n+1,… n +s} the absorbing states. Then, (a) The states { 1,… n } are all transient if and only if the matrix U is non-singular.

(b) The cumulative probability distribution, F(.), of the time until the absorption in one of the absorption states { n+1,… n +s}, given that M(0) = i for 1 ≤ i ≤ m, reads

$$F(t) = 1 - a_i \exp(Ut)\, e \quad t \geq 0 \quad (1.1)$$

where a_i is the n-dimensional row vector whose all components equal to 0 except the it one that it is equal to 1, e is the n-dimensional column vector whose all components are equal to 1, and

$$\exp(Ut) := \sum_{i=0}^{\infty} \frac{(Ut)^i}{i!}$$

with $Ut)^0$ = I the n-by-n identity matrix. Given that M(0) = i, the nth order-moment of time until absorption reads: $\mu_i^n = (1)^n n!\,(a_i \; U^{-n}\, e),\; i \geq 0$ (1.2).

(c) The (i, j)-entry of ($-U^{-1}$), for $1 \leq i, j \leq$ n, is the expected amount of time spent in the transient state j, given that M(0) = i . (d) Let denote the n-by-n diagonal matrix of diagonal entries equal to those of U. The (i,j)-entry of ($U^{-1} \Delta$) for $1 \leq i, j \leq$ n, gives the expected number of visits to state j, given that M(0) = i(e) The (i, j)-entry of ($-U^{-1}$V), for $1 \leq i, j \leq$ n and $n+1 \leq i, j \leq n+s$, is the probability that absorption occurs in the state j, given that M(0) = i.

Proof: Assertions (a) and (b) are proved in [1]. Assertion (c) is the consequence of [1] and [2]. To prove Assertion (d) and (e), consider the intestates, discrete-time, absorbing Markov chain embedded just before the jump times of the Markov chain $\{M(t), t \geq 0\}$, The one-step transition probability matrix of the embedded Markov chain reads :

$$\begin{pmatrix} I-\Delta^{-1}U & -\Delta^{-1}V \\ 0_n & I_s \end{pmatrix}$$

where Is is the s-by-s identity matrix. Theorems [GS97, Theorems 11.4 and 11.6] applied on the embedded Markov chain gives assertion (d) and (e) respectively. Coming back to our problem, in the following section we provide a Markovian Analysis that gives closed-form expressions of the distribution of T_d and G_d , and expected value of G_d [3]. Markovian Analysis- The state of the system is represented by the random variable $I(t) \in \{1,2,..n\}$ ag, where $I(t) \in 1,2,..n\}$ gives the number of copies when the packet has not been delivered to the destination (i.e., for $0 \leq t \leq T_d$) and $I(t) = a$ for $t \leq T_d$. Under the assumptions made in 1.2, $I(t), t < T_d$ is an absorbing, finite-state, continuous-time Markov chain, with absorbing state a (referred to as M from now on). Let P = [p (i; j)] be the infinitesimal generator matrix of M. From the transition rate diagram of M in Fig (1) we find

$$p(i, i+1) = (N-i)\lambda, \quad i = 1, \dots N-1$$

$$p(i, i-1) = (i-1)\mu, \quad i = 2, \dots N$$

$$p(i, a) = i\lambda, \quad i = 1, \dots N$$

$$p(i, i) = -(N)\lambda + (i-1)\mu), \quad i = 2, \dots N$$

$$p(i, j) = 0,$$

otherwise,

MODEL-I

Intestinal generator matrix P of the Markov chain M

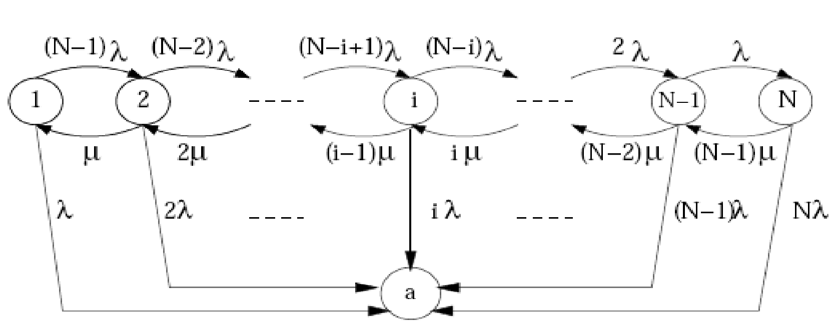

Fig.1

Where Transition rate diagram of M.

$$P = \begin{pmatrix} Q & R \\ 0 & 0 \end{pmatrix}$$

Where $Q = \left[[p(i,i)]_{1 \le i,j \le N} \right]$, $R = (p(1,a), \dots p(N,a)^T)$ and 0 is the N-dimensi-onal row vector whose all components are equal to 0. Let $Q^* = -Q^{-1}$. That shows that Q exists and finds the closed-form expression of it s (i, j)-entry.

The original problem ,The probability distribution of the number of copies at delivery time is given by $P_1[C_d = j]$, and the n^{th}order-moment is given by $E_1[C_d^n]$ [1], where

$$P_1[C_d = j] = q^*(i,j) r(j, a_j)$$

Let $P_i[C_d = j]$ be the probability that the number of copies in the network at the delivery time is j, given there are i copies in the network at time $t = 0$. We assume without loss of generality that the Markov chain M is left-continuous so that$P_i[C_d = j]$ = $P[I(Td) = j]$ (by convention I(t) is the state of the process M just before time t. In words $P_i[C_d = j]$is the probability that the last visited state before absorption is j, given that the initial state is i. If we split the absorbing state a into N absorbing states $a_1, \dots a_n$ as shown in Fig.2, we will not act the dynamics of the original Markov chain before absorption. This means that the matrix Q in of the original absorbing Markov chain is the same as its corresponding matrix of the moiled absorbing Markov chain. Clearly $P_i[C_d = j]$, is now equal to the probability that the moiled chain is absorbed in state a_j . This shows that the N is large the sistem and has a deterministic path MP.

MODEL-II

The model absorbing Markov chain with N absorbing states

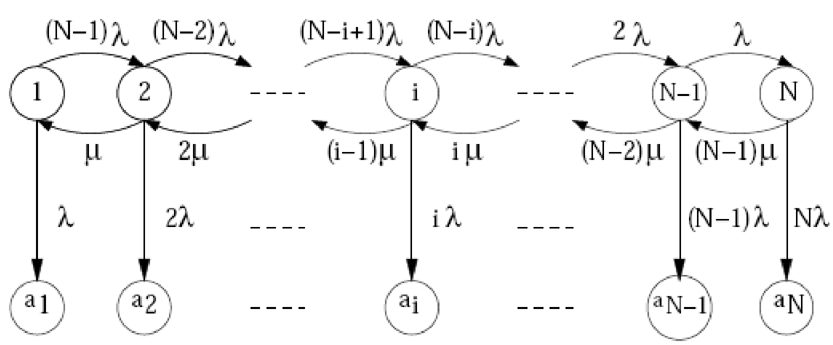

Fig.2

3. Conclusion

There are two models for two-hop relay Routing with limited Packet Lifetime with a single parameter in a random medium. where the source node wants to send a single packet to the destination node. However the construction of two-hop Relay Routing models , has attracted Signing cant attention due to its challenging research problems Indeed, the above mentioned statement of the problem can be done in the following way: any complex behavior based on a finite storage space can be represented as being generated by a realization algorithm for two-hop relay Routing with limited Packet Lifetime and with a finite memory [4].

References:

1. Hanbali A. Al, Nain .P and Altman E., Performance Evaluation of Packet Relaying in Ad Hoc Networks. INRIA Research Report RR-5860, Mars 2006.

2.Groenevelt. R, Nain. P and Koole .G, The Message Delay in Mobile Ad Hoc Networks, *Proc. of Performance 2005*, Juan-les-Pins, France, October 2005. Published in *Performance Evaluation*, Vol. 62, Issues 1-4, October 2005, pp. 210-228.

3. Grossglauser M. and Tse. D. Mobility Increases the Capacity of Ad hoc Wireless Networks, *IEEE/ACM Transactions on Networking*, Vol. 10, No. 4, August, 2002, pp. 477-486.

4. Zhang E. and Neglia G. and Kurose J. and Towsley D. Performance Modeling of Epidemic Routing, *Umass Computer Science* Technical Report 2005-44.

შეზღუდულ დროში ორნახტომიანი პაკეტების გადაცემის ორი მოდელი

ოლეგ ნამიჩეიშვილი[1], ჰამლეტ მელაძე[2], ირმა ასლანიშვილი[2]
1-საქართველოს ტექნიკური უნივერსიტეტი,
2-საქ.საპატრიარქოს წმიდა ანდრია პირველწოდებულის სახ. უნივერსიტეტი

რეზიუმე

განხილულია მობილური საკომუნიკაციო ქსელები, ანუ ad hoc (უსადენო) ქსელები. ბოლო დროს ამ ქსელებმა მკვლევარების ყურადღება მიიქცია, ad hoc ქსელები წარმოადგენს რთულ განაწილებულ სისტემებს, რომლებიც შედგება უსადენო, მობილური ან სტატიკური კვანძებისაგან, რომელთაც გააჩნია თავისუფალი და დინამიკური თვითორგანიზების უნარი. პირველ მოდელში შემოტანილია ორნახტომიანი მექანიზმი, რომელიც შემდეგი სახით მოქმედებს: როდესაც არ არსებობს გზა გამგზავნ კვანძსა და მიმღებ კვანძს შორის. ეს ხორციელდება მიმღებისთვის ინფორმაციის გადასაცემად. სტატიაში შესწავლილია პაკეტის გადაცემის პრობლემები შეზღუდულ დროში. მეორე მოდელი განკუთვნილია ორნახტომიანი მარშუტიზაციისვის. პაკეტის არსებობის შემოსაზღვრული დროით და ერთადერთი პარამეტრით შემთხვევით გარემოში, სადაც საწყისმა კვანძმა უნდა გაუგზავნოს პაკეტი მიმღებ კვანძს. მოყვანილი პრობლემა ფორმულირებულია ასეთი სახით: ნებისმიერი რთული ქცევა, დაფუძვნებული მეხსიერების სასრულ სივრცეზე, შესაძლებელია წარმოდგენილი იქნას როგორც ორნახტომიანი მარშუტიზაციის ალგორითმის რეალიზება პაკეტის არსებობისათვის შეზღუდული დროით და სასრული მეხსიერებით.

ДВЕ МОДЕЛИ ДЛЯ ДВУХСКАЧКОВОЙ МАРШРУТИЗАЦИИ ПРИ ОГРАНИЧЕННОМ ВРЕМЕНИ ЖИЗНИ ПАКЕТА

Намичеишвили Олег[1], Меладзе Гамлет[2], Асланишвили Ирма[2]
1-Грузинский Технический Университет,
2-Грузинский Университет им. Андрея Первозванного при Груз.Патриархии

Резюме

В статье рассмотрены сети мобильной коммуникации, иначе именуемые ad hoc (беспроводными) сетями, которые последнее время привлекли внимание исследователей. Ad hoc сети - сложные распределенные системы, которые состоят из беспроводных мобильных (подвижных) или статических узлов, которые могут свободно и динамически самоорганизовываться. Нами будет использоваться поглощающая марковская цепь с конечным числом состояний и непрерывным временем для реализации этих характеристик на компьютере. Первая модель вводит двухскачковый механизм, который работает следующим образом: когда нет никакого пути между исходным узлом и узлом адресата (назначения), исходный узел передает копии пакетов ко всем соседним узлам. Это осуществляется для доставки информации адресату (получателю). Цель этой работы состоит в том, чтобы изучить проблему доставки пакета за ограниченное время. Вторая модель - для двухскачковой маршрутизации при ограниченном времени жизни пакета с единственным параметром в случайной среде, где исходному узлу следует послать отдельный пакет узлу адресата. Формулировка упомянутой проблемы может быть выражена следующим способом: любое сложное поведение, основанное на конечном пространстве памяти, может быть представлено как генерируемая алгоритмом реализация двухскачковой маршрутизации с ограниченным временем жизни пакета и с конечной памятью.